

## HOW TO MAKE A KEPLER GUEST OBSERVER TARGET TABLE

This document provides instructions that are critical to the creation of an important component of your proposal: the target table. This table must appear in the body of your proposal that is submitted to NRESS, as well as a separate electronic file that is submitted to the Kepler Guest Observer office. Details on how to construct both of these versions of the table are given below.

Kepler has a great deal of flexibility in target scheduling. Long cadence (30-minute) targets must be observed for at least 93 consecutive days (one quarter, between spacecraft rolls) and as long as a whole year in a given GO cycle, and if desired, swapped out for different targets on a quarterly basis. Short cadence (1-minute) targets must be observed for at least 31 consecutive days and as long as a whole year in a given GO cycle, and if desired, swapped out for different targets on a monthly basis. Target uploads for both long and short cadence occurs on a quarterly basis, during the time of a spacecraft roll to reorient the solar panels.

### A) OVERVIEW:

The version of the target table that appears in your proposal should follow the format as shown in the example table below (Table 1). How you construct this table is entirely up to you, but keep in mind that *another version of the same table will have to be submitted separately as an electronic text file to the GO program*. To avoid replication of work and possible inconsistencies in making each of these files separately, we suggest that you follow the below steps, completing the submission process of both the proposal and the separate target table by the proposal deadline:

- (1) download the MS Word template file (<http://keplergo.arc.nasa.gov/>);
- (2) fill out the entries as they should appear in the proposal;
- (3) copy/paste the completed table into your proposal;
- (4) convert the completed MS Word table following a one-step process (see instructions below) to prepare a text file in the format required for submission to the GO office;
- (5) submit your completed proposal to NSPIRES;
- (6) submit your converted target table text file to the GO office;
- (7) kick back and enjoy a cool beverage of your choice.

### B) THE CONTENT OF THE TARGET TABLE:

The target table provides all the information needed to acquire your data in the desired observing mode. Among other parameters, the table specifies:

- when (relative to the beginning of the observing period for this cycle of the GO program) a particular target is being observed and with what cadence;
- the magnitude of the target, which is used by the Science Operations Center to determine, via an automated process, the optimal size and shape of aperture for your target (if a point

source);

- the dimensions of a rectangular aperture, in the case of extended objects or for rare instances in which the automated, optimized aperture is not desirable;
- an aperture “map” to be used, in cases for which a single aperture is inadequate (wasteful of pixels) in covering an extended object.

## B1. Description of Parameter Fields:

Table 1 below demonstrates the flexibility in target scheduling and observational modes, and shows the required format:

Table 1: An example of a target table in the required format

OBJECT	RA Dec	m <sub>KEP</sub>	aper		On-source Monitoring												S/ N	Flag	Comment
					Q1			Q2			Q3			Q4					
			Δx	Δy	1	2	3	4	5	6	7	8	9	10	11	12			
<i>STAR1</i>	hh:mm:ss.s ±dd:mm:ss.s	18.52	0	0	30	30	30	30	30	30	30	30	30	30	30	30	5	ST	Fainter than GOIC
<i>STAR2</i>	hh:mm:ss.s ±dd:mm:ss.s	14.12	0	0	1	1	1	1	0	0	30	30	30	0	0	0	20	1	
<i>STAR3</i>	hh:mm:ss.s ±dd:mm:ss.s	14.44	0	0	0	0	0	0	1	1	1	1	0	30	30	30	35	1	
<i>STAR4</i>	hh:mm:ss.s ±dd:mm:ss.s	12.57	0	0	0	1	0	30	30	30	30	30	30	30	30	30	30	1	
<i>STAR5</i>	hh:mm:ss.s ±dd:mm:ss.s	13.88	0	0	0	0	0	1	1	0	30	30	30	1	0	0	40	0	WR star, Δm=0.1
<i>OBJ1-1</i>	hh:mm:ss.s ±dd:mm:ss.s	17.51	20	28	30	30	30	30	30	30	30	30	30	30	30	30	5	EX	AGN
<i>OBJ1-2</i>	hh:mm:ss.s ±dd:mm:ss.s	18.01	15	34	30	30	30	30	30	30	30	30	30	30	30	30	3	EX	AGN
<i>STAR6</i>	hh:mm:ss.s ±dd:mm:ss.s	16.50	0	0	30	30	30	0	0	0	0	0	0	0	0	0	10	1, TOO	nova
<i>OBJ2</i>	hh:mm:ss.s ±dd:mm:ss.s	15.25	0	0	1	0	0	0	0	0	0	0	0	0	0	0	30	EX, TOO	distant SN

Below is a detailed description of the columns:

- **OBJECT** is the identifier, catalogue or common name of the target – whenever possible the 2MASS catalog id should be used (given in column 14 of the GOIC);
- **RA, Dec** are the coordinates (J2000) of the centroid of the desired aperture;
- **$m_{KEP}$**  is the apparent magnitude as measured through the Kepler bandpass (given in the GOIC for the object or feature being measured; refer to <http://keplergo.arc.nasa.gov> for information regarding magnitude conversions for objects not in the GOIC). Note that if some component of an extended object is what is being measured, then the expected magnitude integrated within the specified aperture about that component is the magnitude that should be listed here. In cases of large expected amplitude variations, list the expected magnitude as averaged over the period of time to be monitored and give the expected amplitude in the comments field so that reviewers are aware of the dimmest and brightest range of expected magnitudes. If all that you have is an upper limit for the magnitude, that limit is what you should give in the table;

- **aper** specifies the length ( $\Delta x$ , east-west) and width ( $\Delta y$ , north-south) of the desired subimage/aperture in units of arcseconds, in an equatorial coordinate system. Note that the pixel rows and columns of the detectors are significantly rotated with respect to this system. A “0” (zero) in both columns indicate that an optimized aperture size as determined by the Kepler Science Operations Center will be used, which is the best (and preferred, from the SOC viewpoint) choice for point sources in most situations. Nonzero numbers in both columns indicate a user-defined rectangular subimage, overriding a SOC optimized aperture. Multiple apertures, e.g., an “aperture map”, can be defined to cover an extended source or irregular area. A figure in the proposal, indicating the location of the labeled apertures with respect to the object, is required if aperture maps are listed in the target table. (In Table 1 “Obj1-1” and “Obj1-2” represent a two-aperture map for such an object; more details below regarding how to specify aperture maps);
- **On-source monitoring** specifies the cadence rate (1-minute or 30-minutes) and the respective quarters (each quarter=93 days) or 31-day increments within a quarter (Q1-1, Q1-2, Q1-3, Q2-4, etc) of Cycle 1 over which the target should be monitored. Long cadence targets may be monitored in quarterly units of time only; short cadence targets may be monitored in monthly (31-day) units of time. A “30” should always appear three consecutive times within a given quarter, in the table. A “1” can appear once, twice or three consecutive times within a quarter, depending on the desired total monitoring time. A “0” (zero) should be listed for time increments in which no monitoring is intended. Note that the following would NOT be allowed because long cadence observations cannot start or stop mid-way within a quarter, but rather must span the whole quarter:

OBJECT	RA Dec	m <sub>KEP</sub>	aper		On-source Monitoring												S/ N	Flag	Comment
					Q1			Q2			Q3			Q4					
			Δx	Δy	1	2	3	4	5	6	7	8	9	10	11	12			
<i>badentry</i>	hh:mm:ss.s ±dd:mm:ss.s	13.02	0	0	1	30	30	30	30	30	30	30	30	30	30	5	1	Monitoring sequence in Q1 is not do-able	

A judicious use of the short cadence targets is essential, given the small number of short cadences allocated to the GO program (25 targets). In other words, do not observe at 1-minute cadence on one particular object for an entire year if only one month of such data will be sufficient to achieve your science objective. Rather, allow the fast cadence slot in those other months to be used for other targets (either yours or other observers) in order to maximize scientific return;

- **S/N** is the anticipated signal-to-noise ratio of the feature in the time series (constructed from a compilation of all proposed data) whose measurement addresses the proposal science objective(s);
- **Flag** is one or more comma-separated parameters describing the nature of the target:
  - EX**: extragalactic object
  - TOO**: target of opportunity
  - ST**: star not listed in the GOIC (might be too faint and/or was not an object for which *griz* photometry was obtained by the Kepler science team)

**0,1:** star listed in the GOIC that is outside (1) or inside (0) the region reserved for Key Project targets. A target with flag=0 (a nominally “off-limits” object) needs to be fully justified in the text as to why it is too inherently “noisy” to be selected as a Key Project target, and accompanied by a brief explanatory comment in the table (in Table 1, star5 is an example of such a target);

If more than one flag descriptor is required to fully characterize the target, then flag codes should be listed together, separated by commas.

- **Comments** should be used to provide brief descriptions of objects or brief justifications for flag=0 targets and non-default aperture size requests associated with stellar targets.

## **B2. Description of Example Entries:**

- **Optimizing short cadence observing by alternating targets:** In the above example, for any given month, only 2 short cadence “slots” are needed (and in some months, only one) for data acquisition of five objects: star2, star3, star4, star5 and obj2. Star2 and star3 demonstrate that short cadence observations can span multiple months and start/stop at any month within any quarter. Long cadence observations can be planned for other quarters, but must extend over the full duration of a quarter, and may not start/stop in the middle of other quarters. Of course you are permitted to use short cadence observing for an object(s) for a whole year, but just make sure that your science goals justify that use of resources. Note that a “0” (zero) means that that data is not being acquired for that object during the indicated period.
- **Situations requiring words in the “comments” field:** A comment is required in three cases:
  - the target has a GOIC flag of 0 (an object in the nominal “off-limits” zone of magnitude/Teff parameter space). Justification must be provided regarding why the object will be unsuitable as a Key Project target (e.g., variability argument, etc);
  - a non-default size for the aperture was specified for a stellar target (e.g., nonzeros appear in  $\Delta x$  and  $\Delta y$ );
  - (not applicable for Cycle 1, but for future cycles) -- the object is a previous GO or inactive Key Project target. Justification must be given regarding why additional data is necessary.

In all such cases, more details should be provided in the proposal text. Star5 is the only example in Table 1 of a situation requiring a comment. The fact that this object has been verified to be a variable star with a large amplitude ( $>0.01\text{mag}$ ) is sufficient to make it available for a GO proposal.

- **Targets of Opportunity:** Observations of TOOs begin at the next target list upload (or quarterly roll) following the trigger event. By convention, the observing mode is indicated by starting with the Q1-1 month, with the understanding that Q1-1 in this case is really the first month in the first quarter following the trigger event, and all other following time periods are relative to this time. For star6, one quarter of long cadence observing after the trigger event is planned. For obj2, one month of short cadence is planned.
- **Aperture size:** With few exceptions, point source targets should use the SOC optimized aperture size, indicated by a “0” (zero) in the two “aper” columns. This optimized aperture

is dependent on the magnitude of the object, and is determined by finding the aperture that maximizes the signal-to-noise ratio. This optimization is performed on all of the Key Project targets, and therefore the procedure is quite robust and reliable. In cases of extended objects, some specification of aperture size will be needed, as is the case for Obj1.

- **Aperture maps:** An aperture map is described for Obj1 in the example target table. An aperture map, multiple apertures covering a single target, are treated as separate objects as far as the observing plan is concerned. The purpose of an aperture map is to minimize unwanted “empty” area within the aperture, allowing those pixels to be used for other targets. For any object requiring the use of multiple objects, an image of the object with overlaying rectangular apertures, each labeled consistently with the entries in the table, is required in the proposal. An example of an aperture map is given below in Figure 1, demonstrating how to label the image in a way that is consistent with the target table. Note that the aperture axes should be aligned with east-west and north-south, respectively. An angular scale bar on the images, as shown below, is also required to give reviewers an at-a-glance sense of the size of the aperture map boxes.

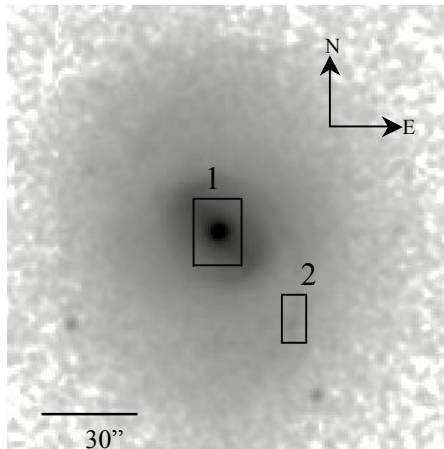


Figure 1: Example of accompanying image for aperture maps for OBJ1, where the target table entries OBJ1-1 and OBJ1-2 correspond to the areas in the box labeled “1” and “2”, respectively. The strong message here is, don’t cover the whole extended object with an aperture if you really just need parts of it to do your science – every Kepler pixel is precious, be frugal! (In this case, “OBJ1-1” and “OBJ1-2” would actually be specified for this target as “M77-1” and “M77-2”. Proposing this target would be a bit pointless, however, seeing as how M77 is not in the Kepler field!)

## **C) PREPARING THE TWO REQUIRED VERSIONS OF THE TARGET TABLE:**

### **C1. The table for insertion into the proposal:**

As mentioned above, an MS Word template file is available for you to use for proposal preparation, and will simplify the process of producing the version of the table to be submitted to the GO office.

#### **If you ARE planning to use the template MS Word file...**

- Download the file at <http://keplergo.arc.nasa.gov/proposal.html>
- Fill out the table, following the guidelines given in Section B above. **IMPORTANT:** If you use the template MS Word file with the intent to convert it later to a text file for submission to the GO office, as will be described in the next section below, the most essential formatting guideline is the following: *do NOT use carriage returns in*

***ANY of the entries, including the columns for Ra, Dec, Flags and Comments.***

To do so will corrupt the format of the converted text file, and will result in the wrong fields being read in when your table is automatically ingested at the Guest Observer office. In the Ra,Dec column, as in all the columns that may require multiple words, you should enter the Ra, followed by a white space (**not with a carriage return!**), followed by the Dec. The table will wrap around the text to display the parameters on two different lines. The only thing that you may safely adjust is font size of the characters and column widths, but do not change other table properties such as the cell splitting/merging, text-wrapping in the cells, etc.

- Copy/paste the table into your proposal document, following the (maximum) 6-page science justification+figures and other tables+references section.

**If you do NOT wish to use the template MS Word file...**

If you do NOT wish to use this template MS Word file, then make sure that whatever table that you do construct has all the fields as given in the example shown above (see Table 1) and looks similar to it. Place the table in a place in your proposal following the (maximum) 6-page science justification+figures and other tables+references section. Note that you will need to separately construct another table for submission to the GO office, and that table is in another required format (See Section C2 and Figure 2 below). Just keep in mind that you may have to generate two different target table files, possibly requiring double effort.

**C2. The table for separate submission to the Guest Observer Office:**

If you have used the provided MS Word template to construct the table that you copy/pasted into your proposal, then converting that file into a form suitable for submission to the GO office is trivial (see below). If you have generated the proposal-version of the table using some other process, you will need to also generate your own version of the table to be submitted to the GO Office (see below).

**IMPORTANT! Whatever method you choose for generating this file, it MUST have the following filename for proper upload into the database at the GO office:**

***propid-name.txt***

where *propid* is the proposal ID number assigned to your proposal by NSPIRES (e.g., 08-KEPLER08-0078) at the time that you submit your proposal, and *name* is your last name. The NSPIRES proposal number will appear in the upper right corner on the first page of the cover material when you download a pdf copy of your proposal after submission. For each proposal that you submit, you should have one corresponding target table file. In the above example, this filename would be 08-KEPLER08-0078.txt.

**If you are planning to convert your MS Word target table file...**

- Open your file.
- Under “File”, choose “Save As”
- Under “Format”, select “Text Only” (not “Text Only with Line Breaks” or any other such option)
- Enter the filename per naming convention as described at the beginning of Section C2.
- Verify that the format of the file contents follows that given above, checking in particular that a stray carriage return did not get inserted into a multiple-worded column entry. Each value that you entered in a table cell should correspond to exactly one line in the text file.
- Email the text file as an attachment to [keplergo@mail.arc.nasa.gov](mailto:keplergo@mail.arc.nasa.gov)

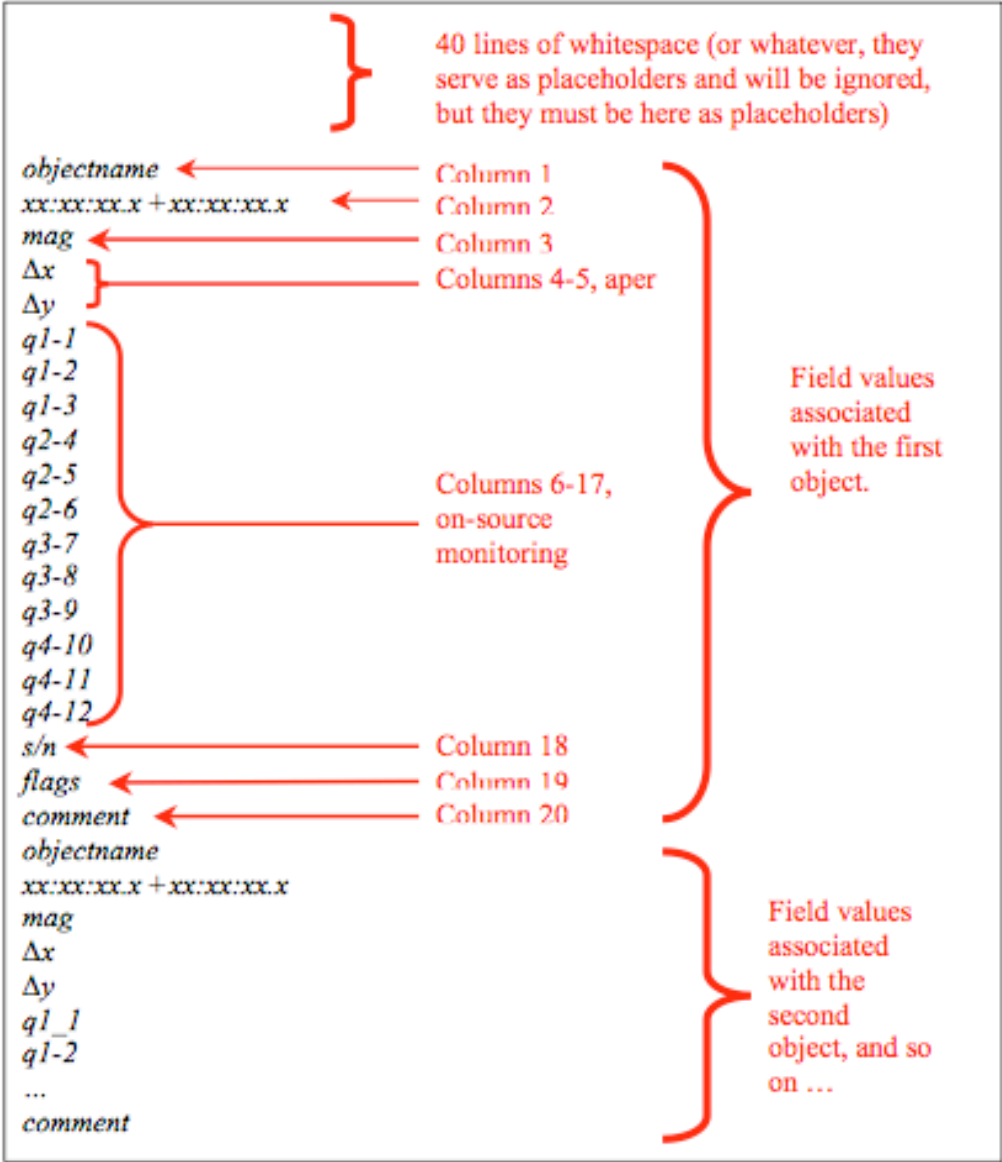
**If you do NOT convert an MS Word file, but rather want to construct your own...**

If you have chosen to create a target table without using the MS Word template for placement in your proposal, then you need to also construct a separate target table (plain text format) to submit to the Guest Observer program. Required steps are:

- Generate your text file per the required format described in detail below, taking care that the contents are identical to the proposal version.
- The file should be assigned a filename per naming convention given at the beginning of Section C2.
- Email the text file as an attachment to [keplergo@mail.arc.nasa.gov](mailto:keplergo@mail.arc.nasa.gov)

The file format should follow that show in Figure 2 (with actual values where there are italicized text):

Figure 2: Format of text target table file for submission to GO office



#### **D) LAST THOUGHTS: COMMON TARGET TABLE PROBLEMS TO AVOID:**

The following is a list of questions to ask yourself, to uncover potential problems in your target table file. These are problems that the GO Office will be looking for, and (depending on the exact problem), could cause your target table (and therefore proposal) to be deemed noncompliant:

- Given the total number of targets, does the file submitted to the GO Office have the **expected number of lines?**

$$\text{\#total lines in file} = 40 + 20 * (\text{\#objects})$$

Following the 40 place-holder lines in the beginning, there should be one line for each of the 20 fields, per object. If an MS Word document was converted to the text file, but a carriage return was inadvertently placed in one of the cells, the number of total lines will be incorrect.

- Do the Ra and Dec values for a given object appear on a single line in the file submitted to the GO office, separated by white space?
- \*With the exception of the “Comments” column, are all cells in the table filled out with non-blank characters?
- If FLAG=0, is there a corresponding COMMENT? (Objects flagged with “0” in the GOIC indicate objects that are in the parameter space from which the Key Project targets will be selected).
- If the  $\Delta x$  and  $\Delta y$  entries are nonzero, and FLAG contains either “ST”, “1” or “0” (e.g., stellar targets), is there a COMMENT explaining why the default SOC-optimized aperture cannot be used?
- If the  $\Delta x$  and  $\Delta y$  entries are nonzero, does the proposal have a figure illustrating the proposed aperture in relation to the targeted object?
- If a “30” appears in ON-SOURCE MONITORING, is the whole quarter in which it appears also “30”? (No starting/stopping long cadences in mid-quarter).
- +If the FLAG indicates the object was previously observed (either through the GO program, or was a Key Project object that was dropped from the monitoring list), was a COMMENT provided to acknowledge this status and give a brief explanation as to why additional data is necessary? (Note: this situation obviously will not be relevant for Cycle 1)
- If an aperture map is specified in the target table (e.g. the same object name repeated in multiple entries, followed by “-1”, “-2”, “-3”, etc.), is there a corresponding figure in the proposal that illustrates the placement of the apertures relative to the targeted object?

**This document applies to Cycle 1 Proposals (ROSES 2008).**